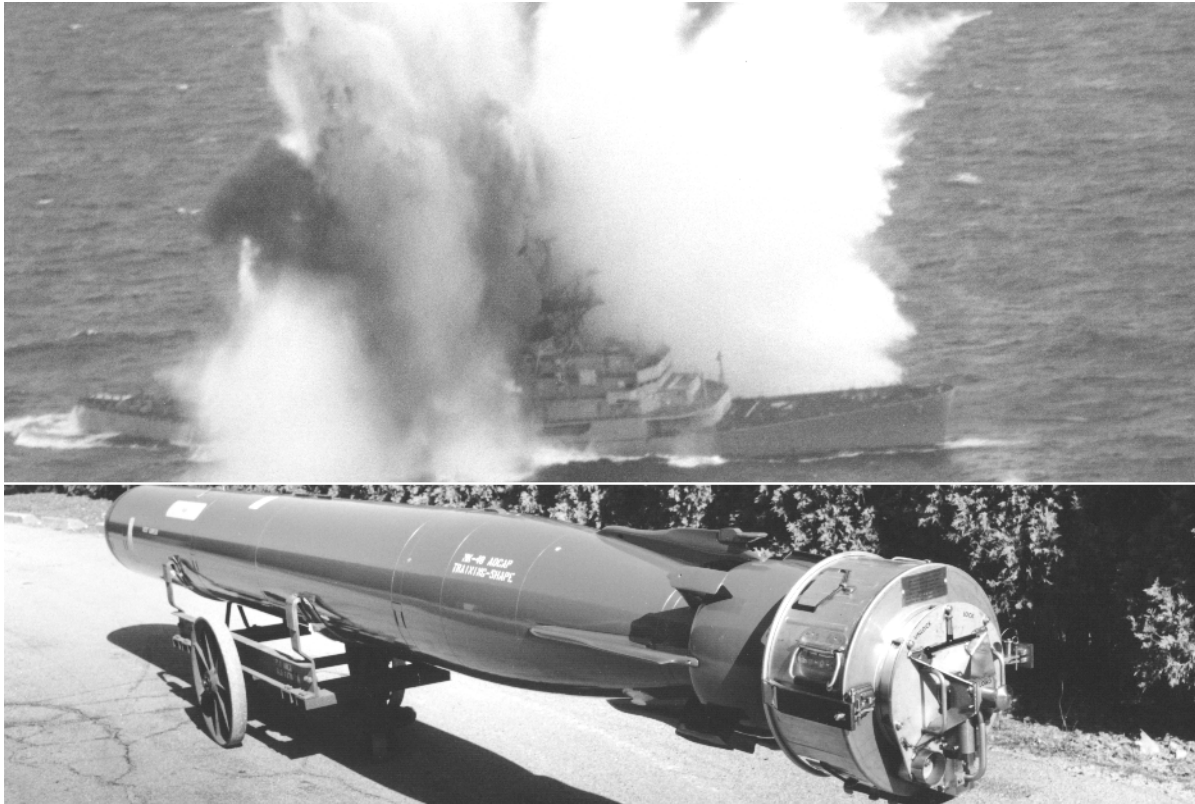


MK 48 ADCAP TORPEDO UPGRADES



Navy ACAT III Program

Total Number of Systems:	MK 48 Mod 5: 1,087 MK 48 Mod 6: 403
Total Program Cost (TY\$):	Through FY99: \$261M Through FY00: \$314M
Average Unit Cost (TY\$):	\$51K
Full-rate production:	Block III: 4QFY97 Block IV: 2QFY01 COT-DV: Under Review CBASS: 3QFY06

Prime Contractor

Northrop Grumman & Raytheon
Electronic Systems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The MK 48 ADCAP torpedo is a submarine launched, heavyweight acoustic homing torpedo with sophisticated sonar and an influence fuzed warhead. The improved ADCAP torpedo includes all digital guidance and control systems, digital fusing systems, and propulsion improvements, which add speed, depth, and range capability. The Mk 48 class torpedoes are the Navy's only submarine launched torpedoes used for engagement of submarine and surface targets, contributing significantly to the submarines' *precision engagement*. They are also essential to the *force protection* role of submarines. There are a number of upgrades to the ADCAP torpedo discussed in the following paragraphs.

There are two hardware modifications to the baseline ADCAP (MK 48 Mod 5), called the G&C (Guidance and Control) MOD and the TPU (Torpedo Propulsion Upgrade) MOD. The G&C MOD replaces the obsolete guidance and control set with current technology, improves the acoustic receiver, adds memory, and improves processor throughput to handle expanded software demands. The TPU MOD improves the torpedo as described in the classified version of this report. Combined these two hardware modifications comprise the MODS ADCAP (MK 48 Mod 6). A follow-on hardware change to the Mod 6 ADCAP, called the Common Torpedo Development Vehicle (COT-DV), had been planned for fleet introduction in FY01, but is now under review, with anticipated introduction no earlier than FY03. COT-DV is a common processor that will use Commercial-off-the-Shelf hardware and require fewer circuit cards than current G&Cs, which may increase its reliability. Its additional processing power may also enable future software enhancements. Another hardware upgrade, Common Broadband Advanced Sonar System (CBASS) is planned for FY06, and its capabilities are described in the classified version of this report.

Three software builds are currently under oversight. Block Upgrade III (BU III) provides near-term improvements to the Mod 5 ADCAP. BU IV, currently under development, is intended to provide mid-term improvements to the Mod 6 ADCAP. The even more sophisticated CBASS software will follow BU IV. All are described in the classified version of this report.

BACKGROUND INFORMATION

The ADCAP torpedo OPEVAL and B-LRIP report were completed in 1988. ADCAP was reported to be operationally effective against certain threats, but not operationally effective against other threats at that time. The system was reported operationally suitable. The Navy subsequently authorized full-rate production, but Congress constrained procurement because of the concerns identified in test reporting. Modifications were implemented by the Navy to improve performance in certain scenarios, upgrade fuzing systems, and improve reliability. These modifications were considered effective. In 1994, a second software upgrade was introduced to improve performance and reliability. DOT&E assessed ADCAP to be operationally effective following this improvement, but some areas remained unsatisfactory. Additional detail, including areas in which DOT&E reached different conclusions than those reached by COMOPTEVFOR are discussed in the classified versions of the FY94 and FY95 Annual Reports.

The Mod 6 ADCAP, intended to address open issues from previous OT&E, was tested in 1995 and reported in the 1996 B-LRIP report. DOT&E assessed Mod 6 ADCAP to be both operationally effective and suitable. Although the reliability was marginally below threshold, DOT&E identified Mod 6 ADCAP as producing a much better total performance against the COEA threat than the baseline Mod 5 ADCAP. Based on modeling and simulation and on torpedo test data, DOT&E also assessed the Mod 6 ADCAP to provide a significant advantage against nuclear submarines using some difficult evasion tactics, although testing was not conducted against submarines employing these specific tactics.

More detail is provided in the classified version of this report.

TEST & EVALUATION ACTIVITY

With the encouragement of DOT&E, the PMS-404 Program Office has taken a lead in a Target-Threat Simulation Validation (TTV) IPT in an effort to provide agreement on the optimal and most realistic threat simulation for both DT and OT for the CBASS. This was the first such target simulation

effort by the submarine force, and it was quickly expanded to encompass all undersea warfare testing, including the SEAWOLF and VIRGINIA programs. TTV has already been used to justify funding applications for both the USS Dolphin upgrade and foreign countermeasure acquisition programs.

DOT&E approved Revision 8 to the TEMP in August 2000. This revision accommodates acquisition strategy adjustments caused by the delay in COT-DV and CBASS hardware development.

This fiscal year's Block IV littoral testing program began and concluded with developmental testing in the Cape Cod Operating Areas. In September 1999, the Navy fired 18 Mod 6 ADCAPs to test improvements to the weapon's shallow water tactical software. In August 2000, 12 more weapons were tested at Cape Cod. The Block IV littoral assessment culminated in the October 2000, when 16 Mod 6 ADCAPs were fired at Cape Cod as part of OPEVAL.

The Prospective Commanding Officer (PCO) school again cooperated with the ADCAP program in its run designs to ensure that some of the events would provide useful torpedo DT data. Most of these runs addressed deep water ASW, including the Close-In Search scenario and Anti-Surface Ship Warfare (ASUW). These exercise torpedo firings in various ADCAP configurations added over 100 inputs to the aggregate torpedo database. The April 2000 Atlantic PCO exercise, included a Dutch diesel-electric submarine (SSK), *Zeeleeuw*. The Australian SSKs *Waller and Collins*, members of the new Collins-class, participated in the July 2000 PCO operations in Hawaii.

The Pacific Submarine force conducted two separate deep water tests, in November and July 2000, to support the development of tactics for the close-in scenario.

An explosion in 1995 of the NUWC land-based dynamometer used to laboratory test torpedoes at deep submergence pressures led to a hiatus on deep/fast target testing. A very limited program of actual in-water deep proofing firings with Mod 6 weapons has been conducted in 1999 and 2000.

Four separate service weapons tests were held, three with Mod 5 weapons, and one with the Mod 6 version, to evaluate the warshot torpedo configuration. There also were two exercises in which Mod 4 warshot weapons were fired at decommissioned surface ship hulks.

In FY01, the Navy is planning to continue its robust schedule of ADCAP torpedo exercises. The standard schedule of PCO exercises will be conducted. Additional cooperative exercises with foreign navies are expected in forward-deployed areas, including the Western Pacific Ocean and the Mediterranean Sea. More details are provided in the classified version of this report.

TEST & EVALUATION ASSESSMENT

Testing was conducted in accordance with the TEMP. The classified version of this report provides details concerning current capabilities that remain untested due to resource limitations.

At the insistence of DOT&E, the ADCAP TEMP includes a requirement for shallow water torpedo tracking instrumentation, in order to better understand weapon performance as it homes in on a submarine target. This capability will assist in scoring and provide valuable ground-truth data for all runs, whether hits or misses, in order to support the goal of testing to learn. The Navy is developing a Target Centered Tracking (TCT) system, which utilizes a strap-on acoustic sensor package aboard a submarine to track incoming weapons. TCT will provide close-in accuracy comparable to or better than most instrumented test ranges, but has the advantage of portability, supporting testing at virtually any

site. The Navy has committed to fully funding TCT, with the first unit due in time for CBASS testing in FY03.

The results of the PCO exercises continue to provide an important amount of information concerning ADCAP performance. More details are provided in the classified version of this report.

Since safety considerations preclude actual target intercepts during exercise firings, warshot performance must be assessed indirectly. Warshot performance is described in detail in the classified version of this report.

Extensive Block IV testing has provided a good look at how the Mod 6 ADCAP is performing in shallow water. More details are provided in the classified version of this report.

The Weapons Analysis Facility (WAF) underwent major planned upgrades in FY00, including the transition to a new laboratory building and new computer hardware. The Newport-based facility provides hardware-in-the-loop torpedo simulation in support of weapon system development and testing. According to the original schedule, the changes should have enabled the use of the latest environmental and target models as part of the Block IV assessment, but delays prevented the achievement of these goals. NUWC attempted to salvage the effort by performing a limited model validation to demonstrate the resolution of several of the deficiencies that had been identified in the 1997 VV&A process. However, COMOPTEVFOR determined that the validation effort did not meet their requirements, choosing instead to rely on the ample database of in-water runs to support their assessment. This is the third OPEVAL in which the WAF has not been able to contribute to the actual operational T&E process. The facility is a valuable asset for development purposes, and could, if properly utilized, provide critical supplementary data for weapons evaluations. In particular, the WAF could simulate target evasions and intercepts that cannot be tested in water due to safety rules. It also could use measured test data against surrogates to project performance against threat targets in environments of interest. In order to achieve these goals, the sponsor will have to be willing to provide additional funding. To date, the WAF has relied heavily on REP funds, but OSD has recently taken note of the fact that this is not an appropriate use of REP resources.

As mentioned in last year's Annual Report, the Navy test organization at Keyport, WA in July 1999 questioned the weapon's reliability. Concerns were expressed that Mod 6 weapons being delivered to the Fleet might not meet specifications under the most challenging conditions. The continued poor proofing results have prompted recommendations to the Program Office that the Fleet be provided guidance to restrict operating depths. DOT&E agrees with these concerns and recommendations. More details are covered in the classified version of this report.

ADCAP reliability continues to run in cycles. More details are provided in the classified version of this report. DOT&E notes that work force reductions at the weapon's depots, caused by resource shortages, may be threatening the Fleet's ability to process weapons quickly and accurately.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Over the past decade, ADCAP development has produced basic performance levels in both deep and shallow water scenarios, but there is room for further improvement. The Program's plan to address future software changes through a progressive improvements scheme, instead of rigid block upgrades, will allow for a more flexible approach to development. Periodic testing will provide the rigorous evaluations necessary for responsible oversight, and DOT&E supports this scheme. However, there are

specific performance limitations, as described in the classified version of this report. DOT&E believes that more competition among available knowledge resources would foster more innovative approaches to solving these problems. DOT&E believes that added emphasis needs to be focused on improving wire performance and reliability. One approach might be the use of fiber-optical guidance wires, as are now used by a number of European torpedoes. Overall torpedo reliability also remains a concern. The reliability problems, whether due to design, manufacturing, or maintenance, must be understood and addressed in order to improve the Fleet's confidence in ADCAP.

As cited in previous reports, some performance questions remain. More details are provided in the classified version of this report. Generally, shallow water testing has generally been done in open ocean without range instrumentation, forcing testers to rely on the tested torpedo's internal monitoring equipment to assess torpedo performance. This can result in post run analysis errors. DOT&E believes that development of an inexpensive mobile, portable test range could prove useful to alleviating some shallow water testing shortfalls. As an interim fix, DOT&E has agreed in the TEMP to shallow water scoring instrumentation, but the Navy does not expect to have such a capability until FY03. The Navy should have provided shallow water scoring instrumentation for FY00 OPEVAL. Additional emphasis should be placed on warshot firings to verify the weapon's ability to hit and sink both surface and subsurface targets.

DOT&E believes that an instrumented shallow water test range would help hasten maturation of littoral anti-diesel submarine tactics and improvement in shallow water ASW torpedoes. The cumbersome nature of open ocean torpedo firings, coupled with seasonal marine mammal habitat restrictions at Cape Cod have significantly lengthened development cycle times. Due to the convenience and availability of deep-water ranges, the Navy still does the significant majority of its torpedo shooting at these sites. Navy and Congressional support for a viable instrumented shallow water test range is strongly recommended.

The Navy's approach of working with foreign diesel submarines, testing ADCAP in actual threat littoral environments, and employing actual off-the-shelf warshot weapons were all positive FY00 initiatives that reflect the Navy's willingness to realistically assess where it stands in littoral undersea warfare, and these initiatives should continue. Inclusion of more challenging tactical and countered scenarios could provide even more benefit.

